

WHAT IS CLAIMED IS::

1. A solid pyrotechnic composition having a total weight, the solid pyrotechnic composition comprising:

about 40 weight percent to about 90 weight percent oxidizer particles, the oxidizer particles having a mean particle size of not greater than about 30 microns and comprising (a) at least one member selected from the group consisting of alkali metal nitrate and ammonium nitrate and (b) at least one member selected from the group consisting of alkali metal perchlorate and ammonium perchlorate; and

organic crystalline particles and optionally one or more salts of the organic crystalline particles, the organic crystalline particles and the optional salts of the organic crystalline particles accounting for about 10 weight percent to about 60 weight percent of the total weight of the solid pyrotechnic composition.

2. A solid pyrotechnic composition according to claim 1, wherein the oxidizer particles comprise potassium nitrate.

3. A solid pyrotechnic composition according to claim 1, wherein the oxidizer particles comprise potassium perchlorate.

4. A solid pyrotechnic composition according to claim 1, wherein the mean particle size of the oxidizer particles is in a range of 5 microns to 20 microns.

5. A solid pyrotechnic composition according to claim 1, wherein the oxidizer particles constitute 65 weight percent to 80 weight percent of the solid pyrotechnic composition.

6. A solid pyrotechnic composition according to claim 1, wherein 0.5 weight percent to 30 weight percent of the total weight of the solid

pyrotechnic composition consists of the member selected from the group consisting of alkali metal perchlorate and ammonium perchlorate.

7. A solid pyrotechnic composition according to claim 1, wherein 5 weight percent to 20 weight percent of the total weight of the solid pyrotechnic composition consists of the member selected from the group consisting of alkali metal perchlorate and ammonium perchlorate.

8. A solid pyrotechnic composition according to claim 1, wherein 5 weight percent to 20 weight percent of the total weight of the solid pyrotechnic composition consists of potassium perchlorate.

9. A solid pyrotechnic composition according to claim 1, wherein the organic crystalline particles comprise at least one member selected from the group consisting of phenolphthalein and an organic crystalline compound derived from reaction between a phenolic compound and phthalic anhydride.

10. A solid pyrotechnic composition according to claim 1, wherein the organic crystalline particles comprise phenolphthalein.

11. A solid pyrotechnic composition according to claim 10, wherein 13 weight percent to 22 weight percent of the solid pyrotechnic composition consists of phenolphthalein and optionally a salt of phenolphthalein.

12. A solid pyrotechnic composition according to claim 1, wherein the organic crystalline particles and the optional salts of the organic crystalline particles have a mean particle size not greater than about 30 microns.

13. A solid pyrotechnic composition according to claim 1, wherein the organic crystalline particles and the optional salts of the organic crystalline particles have a mean particle size not greater than 15 microns.

14. A solid pyrotechnic composition according to claim 1, wherein the solid pyrotechnic composition has a weight ratio of the organic crystalline particles to the salts of the organic crystalline particles of at least 80:20.

15. A solid pyrotechnic composition according to claim 1, wherein the solid pyrotechnic composition is free of the salts of the organic crystalline particles.

16. A solid pyrotechnic composition according to claim 1, further comprising a non-hygroscopic polymeric binder, the non-hygroscopic polymeric binder having a moisture uptake of not more than 4 weight percent at 75 percent relative humidity and 21.1°C (70°F) over a period of 24 hours.

17. A solid pyrotechnic composition according to claim 16, wherein the non-hygroscopic polymeric binder constitutes no more than about 10 weight percent of the total weight of the solid pyrotechnic composition.

18. A solid pyrotechnic composition according to claim 16, wherein the non-hygroscopic polymeric binder constitutes 3 weight percent to 6 weight percent of the total weight of the solid pyrotechnic composition.

19. A solid pyrotechnic composition according to claim 16, wherein the non-hygroscopic polymeric binder comprises poly(vinyl acetate).

20. A solid pyrotechnic composition according to claim 16, wherein the non-hygroscopic polymeric binder comprises at least one member selected from the group consisting of ethyl cellulose and nylon.

21. A solid pyrotechnic composition according to claim 16, wherein the non-hygroscopic polymeric binder comprises at least one member selected from the group consisting of poly(vinyl acetate-co-vinyl alcohol), nylon,

poly(ethylene-co-vinyl acetate), polyethylene glycol, nitrocellulose, and chain-extended BAMO.

22. A solid pyrotechnic composition according to claim 1, wherein the solid pyrotechnic composition is free of sulfur and charcoal.

23. A solid pyrotechnic composition according to claim 1, wherein the solid pyrotechnic composition has a moisture uptake of not greater than 0.25 weight percent at 75 percent relative humidity and 21.1°C (70°F) over a period of 24 hours.

24. A solid pyrotechnic composition according to claim 1, wherein the solid pyrotechnic composition is formulated to have, upon ignition, a theoretical flame temperature not greater than 2300K.

25. A solid pyrotechnic composition according to claim 1, wherein the solid pyrotechnic composition is formulated to have, upon ignition, a theoretical flame temperature in a range of 1750K to 2300K.

26. A solid pyrotechnic composition having a total weight, the solid pyrotechnic composition comprising:

about 40 weight percent to about 90 weight percent oxidizer particles, the oxidizer particles having a mean particle size of not greater than about 30 microns and comprising at least one member selected from the group consisting of alkali metal perchlorate and ammonium perchlorate, and optionally comprising at least one member selected from the group consisting of alkali metal nitrate and ammonium nitrate; and

organic crystalline particles and optionally one or more salts of the organic crystalline particles, the organic crystalline particles and the optional salts of the organic crystalline particles accounting for about 10 weight percent to about 60 weight percent of the total weight of the solid pyrotechnic

composition,

wherein about 20 weight percent to about 90 weight percent of the solid pyrotechnic composition consists of the member selected from the group consisting of alkali metal perchlorate and ammonium perchlorate.

27. A solid pyrotechnic composition according to claim 26, wherein the oxidizer particles comprise the member selected from the group consisting of alkali metal nitrate and ammonium nitrate.

28. A solid pyrotechnic composition according to claim 26, wherein the oxidizer particles comprise potassium nitrate.

29. A solid pyrotechnic composition according to claim 26, wherein the oxidizer particles comprise potassium perchlorate.

30. A solid pyrotechnic composition according to claim 26, wherein the mean particle size of the oxidizer particles is in a range of 5 microns to 20 microns.

31. A solid pyrotechnic composition according to claim 26, wherein 30 weight percent to 90 weight percent of the total weight of the solid pyrotechnic composition consists of the member selected from the group consisting of alkali metal perchlorate and ammonium perchlorate.

32. A solid pyrotechnic composition according to claim 26, wherein 30 weight percent to 90 weight percent of the total weight of the solid pyrotechnic composition consists of potassium perchlorate.

33. A solid pyrotechnic composition according to claim 26, wherein 65 weight percent to 80 weight percent of the total weight of the solid pyrotechnic composition consists of the oxidizer particles.

34. A solid pyrotechnic composition according to claim 26, wherein the organic crystalline particles comprise at least one member selected from the group consisting of phenolphthalein and an organic crystalline compound derived from reaction between a phenolic compound and phthalic anhydride.

35. A solid pyrotechnic composition according to claim 26, wherein the organic crystalline particles comprise phenolphthalein.

36. A solid pyrotechnic composition according to claim 35, wherein 13 weight percent to 22 weight percent of the solid pyrotechnic composition consists of phenolphthalein and an optional salt of phenolphthalein.

37. A solid pyrotechnic composition according to claim 26, wherein the organic crystalline particles and the optional salts of the organic crystalline particles have a mean particle size not greater than about 30 microns.

38. A solid pyrotechnic composition according to claim 26, wherein the organic crystalline particles and the optional salts of the organic crystalline particles have a mean particle size not greater than 15 microns.

39. A solid pyrotechnic composition according to claim 26, wherein the solid pyrotechnic composition has a weight ratio of the organic crystalline particles to the salts of the organic crystalline particles of at least 80:20.

40. A solid pyrotechnic composition according to claim 26, wherein the solid pyrotechnic composition is free of the salts of the organic crystalline particles.

41. A solid pyrotechnic composition according to claim 26, further comprising a non-hygroscopic polymeric binder, the non-hygroscopic

polymeric binder having a moisture uptake of not more than 4 weight percent at 75 percent relative humidity and 21.1°C (70°F) over a period of 24 hours.

42. A solid pyrotechnic composition according to claim 41, wherein the non-hygroscopic polymeric binder constitutes no more than about 10 weight percent of the total weight of the solid pyrotechnic composition.

43. A solid pyrotechnic composition according to claim 41, wherein non-hygroscopic polymeric binder constitutes 3 weight percent to 6 weight percent of the total weight of the solid pyrotechnic composition.

44. A solid pyrotechnic composition according to claim 41, wherein the non-hygroscopic polymeric binder comprises poly(vinyl acetate).

45. A solid pyrotechnic composition according to claim 41, wherein the non-hygroscopic polymeric binder comprises at least one member selected from the group consisting of ethyl cellulose and nylon.

46. A solid pyrotechnic composition according to claim 41, wherein the non-hygroscopic polymeric binder comprises at least one member selected from the group consisting of poly(vinyl acetate-co-vinyl alcohol), nylon, poly(ethylene-co-vinyl acetate), polyethylene glycol, nitrocellulose, and chain-extended BAMO.

47. A solid pyrotechnic composition according to claim 26, wherein the solid pyrotechnic composition is free of sulfur and charcoal.

48. A solid pyrotechnic composition according to claim 26, wherein the solid pyrotechnic composition has a moisture uptake of not greater than 0.3 weight percent at 75 percent relative humidity and 21.1°C (70°F) over a period of 24 hours.

49. A solid pyrotechnic composition according to claim 26, wherein the solid pyrotechnic composition has a moisture uptake of not greater than 0.25 weight percent at 75 percent relative humidity and 21.1°C (70°F) over a period of 24 hours.

50. A solid pyrotechnic composition according to claim 26, wherein the solid pyrotechnic composition is formulated to have, upon ignition, a theoretical flame temperature greater than 2300K.

51. A solid pyrotechnic composition according to claim 26, wherein the solid pyrotechnic composition is formulated to have, upon ignition, a theoretical flame temperature in a range of 2300K to 3000K.

52. A method of making a solid pyrotechnic composition having a total weight, the method comprising:

(a) combining an alkali metal hydroxide with at least one organic crystalline compound to produce a solution comprising a salt of the organic crystalline compound;

(b) combining the solution with nitric acid to form alkali metal nitrate particles and to convert the salt back to the organic crystalline compound in particulate form, the alkali metal nitrate particles and the organic crystalline compound in particulate form each having a mean particle size of not greater than about 30 microns; and

(c) combining the alkali metal nitrate particles and the organic crystalline compound in particulate form with additional oxidizer particles to form the pyrotechnic composition, the additional oxidizer particles having a mean particle size of not greater than about 30 microns and comprising at least one member selected from the group consisting of alkali metal perchlorate and ammonium perchlorate, the additional oxidizer particles optionally also comprising at least one member selected from the group

consisting of alkali metal nitrate and ammonium nitrate; and

(d) optionally drying the pyrotechnic composition and obtaining the solid pyrotechnic composition,

wherein about 40 weight percent to about 90 weight percent of the total weight of the solid pyrotechnic composition consists of the alkali metal nitrate particles and the additional oxidizer particles.

53. A method according to claim 52, wherein the alkali metal nitrate particles comprise potassium nitrate.

54. A method according to claim 52, wherein the additional oxidizer particles comprise potassium perchlorate.

55. A method according to claim 52, wherein the organic crystalline compound comprises phenolphthalein.

56. A method according to claim 52, wherein the solid pyrotechnic composition is free of the salt of the organic crystalline compound.

57. A method according to claim 52, further comprising adding a non-hygroscopic polymeric binder, the non-hygroscopic polymeric binder having a moisture uptake of not more than 4 weight percent at 75 percent relative humidity and 21.1°C (70°F) over a period of 24 hours.

58. A method according to claim 52, wherein the solid pyrotechnic composition is free of sulfur and charcoal.

59. A method of making a pyrotechnic composition having a total weight, the method comprising:

(a) combining an alkali metal hydroxide with at least one organic crystalline compound to produce a solution comprising a salt of the organic crystalline compound;

(b) combining the solution with perchloric acid to form alkali metal perchlorate particles and to convert the salt back to the organic crystalline compound in particulate form, the alkali metal perchlorate particles and the organic crystalline compound in particulate form each having a mean particle size of not greater than about 30 microns; and

(c) combining the alkali metal perchlorate particles and the organic crystalline compound in particulate form with additional oxidizer particles to form the pyrotechnic composition, the additional oxidizer particles having a mean particle size of not greater than about 30 microns and comprising at least one of (i) at least one member selected from the group consisting of alkali metal nitrate and ammonium nitrate and (ii) at least one member selected from the group consisting of alkali metal perchlorate and ammonium perchlorate; and

(d) optionally drying the pyrotechnic composition and obtaining the solid pyrotechnic composition,

wherein about 40 weight percent to about 90 weight percent of the total weight of the solid pyrotechnic composition consists of the alkali metal perchlorate particles and the additional oxidizer particles.

60. A method according to claim 59, wherein the additional oxidizer particles comprise potassium nitrate.

61. A method according to claim 59, wherein the alkali metal perchlorate particles comprise potassium perchlorate.

62. A method according to claim 59, wherein the organic crystalline compound comprises phenolphthalein.

63. A method according to claim 59, wherein the solid pyrotechnic composition is free of the salt of the organic crystalline compound.

64. A method according to claim 59, further comprising adding a non-hygroscopic polymeric binder, the non-hygroscopic polymeric binder having a moisture uptake of not more than 4 weight percent at 75 percent relative humidity and 21.1°C (70°F) over a period of 24 hours.

65. A method according to claim 59, wherein the solid pyrotechnic composition is free of sulfur and charcoal.